JAPANESE SUMMER FISHERY FOR ALBACORE (*GERMO ALALUNGA*)

RESEARCH REPORT 52

FISH AND WILDLIFE SERVICE

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ABSTRACT

The important albacore fishery carried on by a fleet of Japanese live-bait tuna boats in the spring and early summer in the northwestern Pacific is described. An account is given of the historical background of the fishery, and the magnitude of its production is compared with other Japanese albacore fisheries and with the United States west coast fishery. The seasonal trends in landings, geographical distribution of bases and fishing grounds, and the marketing and utilization of the catch are discussed. The fishery is shown to be the largest in the world for this species, although only a recent outgrowth of, and still subsidiary to, the Japanese skipjack fishery, and to be largely dependent on foreign markets for its support.

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Translator

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Japan is by far the world's greatest producer of albacore tuna (*Germo alalunga*). Since 1952 the Japanese annual landings of this species have been from two to three times as large as those of the United States, the second largest producing nation (table 1). All but a negligible fraction of the Japanese catch comes from the following three sources: Pole-and-line fishing with live bait, mainly in the spring and early summer, in the North Pacific east of the home islands; longline fishing, principally in winter, in the western and central North Pacific; and longline fishing throughout the year in the tropical Pacific and Indian Oceans. Landings of tropical albacore make the smallest contribution to the total, although they have increased sharply in recent years, as indicated by catch data from the operations of mothership fleets (table 2). The longline and the pole-and-line catches from the North Pacific have been of comparable size in several of the years for which records are available; however, despite occasional years in which the longline catch has exceeded the pole-and-line catch, the latter is normally the biggest element in the Japanese albacore landings (table 3).

Table 1.—Annual landings of albacore on the Pacific coasts of Japan and the United States, 1930–56

[In tons]

Year	Japan [1]	United States [2]
1930	17,615	143
1931	20,000	18
1932	15,840	310
1933	17,437	1
1934	12,557	60
1935	16,787	1,193
1936	10,600	492
1937	14,804	1,760
1938	16,000	8,848
1939	18,818	9,459
1940	20,330	7,250
1941	----------	5,966
1942	----------	10,458
1943	----------	14,009
1944	----------	26,397
1945	----------	19,741
1946	902	12,070
1947	9,535	13,422
1948	8,083	24,680
1949	20,572	27,397
1950	32,628	36,207
1951	32,999	17,245
1952	65,788	26,278
1953	56,985	17,417
1954	57,145	13,499
1955	44,724	14,866
1956	64,675	20,310

[1] The 1930 figure is from Aikawa (1949, p. 456), where the source is identified only as Agriculture and Forestry Statistical Tables. The figures for 1931 to 1937 are from Hasegawa (1938). The 1938 figure is from Machino (1949) and was estimated by him from the number of fish landed. Figures for 1939, 1940, 1950, and 1951 are from Survey of the Domestic Tuna Industry (Anderson et al., 1953). The 1946 to 1949 figures were taken from or deduced from data in Katsuo to Maguro, Japan Federation of Tuna Fishery Cooperatives Nos. 5, 16, and 26; they were noted in the source as probably 25 to 33 percent incomplete. Figures for 1952 to 1956 are from annual reports of catch statistics published by the Statistics and Survey Division of the Japanese Ministry of Agriculture and Forestry. It should be noted that various sets of catch statistics available present many large discrepancies, and their accuracy is dubious.

[2] The figures for 1930 to 1943 and 1950 and 1951 are from Survey of the Domestic Tuna Industry (Anderson et al., 1953). Figures for 1944 to 1954 are otherwise from Fishery Statistics of the United States, the U.S. Fish and Wildlife Service. The 1954 to 1956 figures are from published data of the Fish and Wildlife Service and California Division of Fish and Game.

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Table 2.—Albacore landings of Japanese mothership fleets and foreign-based operations, 1950–56

[In tons]

Year	Mothership fleets	Foreign bases
1950	48	----------
1951	137	----------
1952	79	----------
1953	320	----------
1954	3,920	270
1955	5,409	3,228
1956	4,069	3,781

Sources: Annual Reports of Catch Statistics, Statistics and Survey Division, Japanese Ministry of Agriculture and Forestry; 1956 figures ascribed to Japanese Fisheries Agency in Weekly Report No. 49 of the Tuna Research Foundation Division, California Fish Canners Association.

Table 3.—Albacore catches of the Japanese pole-and-line and longline fisheries, 1931–37 and 1946–56

[In tons]

Year [1]	Pole-and-line	Longline
1931	12,000	8,000
1932	8,910	6,930
1933	9,712	7,725
1934	7,376	5,181
1935	4,816	11,971
1936	1,600	9,000
1937	804	14,000
1946	----------	902
1947	7,303	2,232
1948	1,932	6,151
1949	6,650	13,922
1950	14,179	18,423
1951	15,984	12,549
1952	46,109	19,401
1953	36,301	20,522
1954	30,950	26,145
1955	26,724	17,842
1956	36,801	17,379

[1] The figures for 1931 to 1937 are actually given in the source as summer (May–July) and winter (October–April) catches, and probably do not represent with complete accuracy a breakdown by fishing method.

Sources: The figures for 1931 to 1937 are from Hasegawa (1938). (The same figures appear in the journal Kaiyo Gyogyo, No. 4, 1936, for the period of 1931 through part of 1936, and are there ascribed to Operations Reports of the Frozen Tuna Association.) The figures for 1946 to 1951 are drawn from data in Katsuo to Maguro, Nos. 5, 16, 26, and 28, Japan Federation of Tuna Fishery Cooperatives, where some of them are noted as being probably 25 to 33 percent incomplete. Figures for 1952 to 1955 are from the Annual Report of Catch Statistics, Statistics and Survey Division, Japanese Ministry of Agriculture and Forestry, for the year concerned. The 1956 figures are taken from Weekly Reports Nos. 30 and 42 of the Tuna Research Foundation Division, California Fish Canners Association, where they are referred respectively to a trade newspaper and to the Japan Federation of Tuna Fishery Cooperatives.

It is this pole-and-line, live-bait albacore fishery, carried on in spring and early summer in the western North Pacific, that is t subject of this paper. The materi for the paper is drawn almost e tirely from publications, most them Japanese, and to a slight e tent from firsthand observation an from personal communication wit Japanese authorities. Unfortu nately, many aspects of the fishe do not appear to be well doc mented. There is, as far as t writer knows, no comprehensiv treatment of this important fishe in the Japanese literature. A sligh digression here may explain th apparent neglect on the part Japanese writers. Basically, t Japanese draw a sharp distinctio between the terms "katsuo," whic is similar to the broad usage of t English "bonito" in that it mea specifically the skipjack but i cludes generically several oth small, striped tunalike fishes, an "maguro," specifically the bluef or black tuna, but including gene ically all of the larger tunas—t yellowfin, bigeye, and albacore and in older usage, even the spea fishes. On the basis of this distin tion, the Japanese customaril speak of their katsuo fishery (th is, the pole-and-line, live-bait fis ery, which has the skipjack as i primary object) and their magu fishery (the tuna longline fishe which takes a variety of tunas well as spearfishes and sharks Albacore, the smallest of the m guro, are taken by both fisheries b are of primary importance in ne ther, and thus they tend to be ove looked when general treatises either fishery are written by nati authorities.

Another point of caution when using the Japanese literature on albacore fishing is that Japanese writers often imply that all pole-and-line fishing is done in the summer and all longline fishing in winter, whereas the real picture seems to be a bit more complex. Apparently, some albacore are taken by both methods in all months of the year, and it appears that some boats, particularly in winter, go to sea prepared to use both techniques, setting their longlines and then scouting the vicinity of the set for surface schools which can be fished with live bait.[1] It is doubtful, therefore, whether the published statistics, such as those in table 3, give a completely accurate breakdown of the albacore catch by fishing method.

DEVELOPMENT OF ALBACORE SUMMER FISHERY

The Japanese pole-and-line fishery for skipjack, of which the summer fishery for albacore is an outgrowth, is of considerable antiquity. The oldest Japanese history, the semilegendary Nihongi, mentions skipjack angling in the year 124 A.D. by the Emperor. A later chronicle, Hojo Godaiki, in a reference to events in 1537, describes the annual summer migration of the skipjack northeastward along the Japanese coasts, and a work published in 1798, Sankai Meisan Zukai, mentions the use of live bait and pictures horn and feather lures similar to those in use today. (These historical notes are from Yamaguchi 1947.) Thus, the fishing technique appears to have evolved to nearly its present form by the end of the 18th century. Further development of the fishery had to wait on the adoption of engines for propulsion and the construction of larger vessels along western lines. These changes began in the first decade of the present century and have continued to the present day.

It is doubtful whether the Japanese pole-and-line fishery took many albacore in its early years.[2] For one thing, the small sail- and oar-propelled vessels in use before this century worked only a few miles offshore, fishing schools of skipjack which, according to some Japanese authorities (Imamura 1953; Yamaguchi 1947), used to migrate much closer to the coasts than they do now. Nowadays, at least, the albacore seem to approach the coast less than the skipjack, as evidenced by the fact that in 1953, for example, albacore made up only 4 percent of the catch of the large fleet of coastal (less than 20 tons gross) live-bait boats as compared with 33 percent for the

[1] For example, a Tokai University Industrial Science Laboratory fishing situation report for February 21, 1957, has more than 100 boats making good catches of 8 to 14 pound albacore on pole and line close in to the northeast coast of Honshu.

[2] Linguistic evidence indicates a closer and longer familiarity of the Japanese with the skipjack than with the albacore. The word for skipjack, "katsuo," is not readily analyzable, although a traditional etymology derives it from "katai uo," literally hard fish. The two common names for the albacore, "bincho" or "binnaga maguro" and "tombo shibi," on the other hand, apparently are comparatively recent formations meaning long-sideburn tuna and dragonfly tuna.

high-seas (more than 20 tons) fleet (Japanese Ministry of Agriculture and Forestry, 1955). For another thing, the pole-and-line method permits the fisherman to select to some extent the kind of fish that he will try to catch, and the albacore has never been a prized species for domestic consumption in Japan. The Japanese customarily eat fresh tuna raw; otherwise they preserve the fish, principally skipjack, by boiling it and drying it very hard (katsuobushi). The albacore, with its soft, pale flesh, is not very suitable for either use.[3] In the days before the export trade in albacore arose, the Japanese longline fishermen, whose fishing method is less selective than that of the pole-and-line fisherman, regarded the albacore as a bait-stealing pest and shifted to new fishing grounds when too many of the long-finned tuna were hooked on their lines. It seems probable, therefore, that for more than 2 decades after large, powered skipjack boats began to operate far enough offshore to be in albacore waters the production of this species was low in Japan.

The summer fishery for albacore, as a deliberate diversion of fishing effort from skipjack to albacore, is a development of the last 30 or 35 years. It arose in response to the requirements of California packers, who had built up a market for canned white-meat tuna only to find themselves without raw materials as a result of the failure of the California albacore fishery in the late twenties and early thirties. It is maintained despite the recovery of the United States west coast fishery, because of a continuing demand in the United States for frozen and canned Japanese albacore. Without this export market, there is little doubt that the Japanese live-bait fleet would shift much of the effort expended at present on albacore fishing to fishing for skipjack and small bigeye and yellowfin.

The total annual production and export of Japanese albacore through the 1930's and up to World War II showed considerable variation from year to year but no consistent trends (tables 1 and 4). What the total figures do not show, however, was the drastic drop in pole-and-line catch in the late thirties (table 3). A concerted effort was made to compensate for this decline by increasing the longline catch. Exploratory fishing vessels of the Japanese Government scouted summer longlining grounds as far away as the Midway Island area, and research was done on the problem of "green meat," which was more acute in albacore taken by longline than by bait boats.

No production figures for the war years have been found, but it is clear that albacore fishing continued at least into 1943 (Kimura, 1949). At that time the wartime food shortages probably supplied an incentive sufficient to replace the vanished export market. During World War II, the larger fishing boats were gradually taken over by

[3] Market reports in Japanese trade journals have occasionally recorded high bids for small quantities of small albacore by manufacturers of dried tuna loins, which indicate a certain demand for this unusual product.

Table 4.—Japanese exports of frozen and canned albacore, 1931–39

Year	Frozen (tons)	Canned	
		Cases	Tons of raw material
1931	3,672	28,359	567
1932	1,274	258,026	5,106
1933	1,699	680,282	13,606
1934	2,070	281,715	5,634
1935	3,444	458,354	9,167
1936	2,928	480,308	9,616
1937	3,712	781,053	15,621
1938	2,253	322,043	6,441
1939	3,532	788,759	15,755

Sources: Figures on frozen exports are from Survey of the Domestic Tuna Industry (Anderson et al., 1953) and are said to cover exports to the United States and Canada only. Figures on canned exports are from Shapiro (1948), where they are ascribed to the Japan Canning Company.

the military for use as troop supply boats in the forward areas, as coastal freighters in home waters, or as picket boats. By the last year of the war most of the fleet was exposed to Allied air and sea attack and much of it was destroyed. Kimura (1949) notes that in 1942 the number of large bait boats in operation was cut to less than half that of the preceding year, that the number was further decreased in 1943, and he presents no data at all on pole-and-line tuna fishing for the years 1944 to 1946. One sees statements that almost all the large vessels of the Japanese tuna fleet were destroyed by the end of the war (Japan Federation of Tuna Fishery Cooperative Associations, 1951), however, according to the Japanese Fisheries Agency (1955), in 1945 the fleet was down to 33 percent in number of boats and 52 percent in tonnage of the 1939 level. Meanwhile, there had been developments on the west coast of North America that were to be an important factor in stimulating the postwar recovery of the Japanese albacore fishery. In 1937, sizeable landings of albacore were made for the first time in the North Pacific Coast States of Oregon and Washington (Powell and Hildebrand, 1950). The landings in this area grew for several years, reaching a peak of 34 million pounds in 1944 and causing establishment of a number of canneries in the Northwest. The landings then declined sharply and remained at a comparatively low level (10 to 15 million pounds) until 1953, when they dropped to almost nothing (Anderson and Power, 1953). Thus when the Japanese got their live-bait tuna fleet back into full-scale operation after the war, they found an expanded export market for frozen albacore waiting for them.

The recovery of the Japanese tuna fleet in the postwar years was rapid and thorough. Within 2 years after the end of hostilities, the number of tuna boats was apparently greater than it had been in 1940, and there has been an unsteady upward trend in the size of the fleet and a steady increase in the average tonnage of the boats during the 10 years following the war (table 5). Albacore catches have risen to unprecedented heights in the last 4 or 5 years, and the resource shows no signs of failing under the fishing pressure. The serious problems of the fishery are all related to fluctuations, natural and artificial, in the United States demand for Japanese albacore and to the competition between various elements of the Japanese fishing industry for a share in the export trade.

Table 5.—Japanese tuna fleet, by years, 1940 and 1947–55

Year	Number of boats	Total		Average	
		Tonnage	Horsepower	Tonnage	Horsepow
1940	[1] 708	47, 297	94, 122	67	
1947	956	72, 864	127, 512	76	
1948	1, 146	94, 230	170, 969	82	
1949	1, 163	96, 426	181, 707	83	
1950	1, 100	92, 158	196, 098	84	
1951	1, 187	101, 471	221, 334	85	
1952	1, 130	103, 815	227, 638	92	
1953	1, 154	112, 945	249, 439	98	
1954	1, 263	142, 892	293, 523	113	
1955	1, 372	176, 026	389, 837	128	

[1] There were 335 other boats of unknown tonnage.
Source: Katsuo to Maguro, February 1956, Japanese Federation of Tuna Fishing Cooperative Associations.

PHYSICAL SETTING OF THE FISHERY

The Japanese home islands of Honshu, Kyushu, and Shikoku form an arc trending roughly northeastward between 31° N. and 41° N. latitude at 130° E. to 142° E. longitude (fig. 1). A line of small islands and reefs leads south from the southern tip of Kyushu to Okinawa and Formosa, and another chain, the Nampo [Nanpo] Shotō, runs south from central Honshu to the Bonins, the Volcano Islands, and the Marianas. For tuna fishery statistics, the areas south and east of the home islands are divided as follows: Satsunan area, waters west of 130° E., that is, west of Kyushu and including the Ryukyus; Kinan area, waters south of Kyushu, Shikoku, and central Honshu, between 130° E. and 140° E. longitude; Zunan area, east of 140° E. longitude and north to 35° N. latitude, taking in the islands of Nampo Shotō; and Tōhoku or the northeastern area, waters north of 35° N. latitude and east of northern Honshu.[4] Only the Kinan, Zunan, and Tōhok areas contain significant fishin grounds of the albacore summe fishery.

The warm current, Kuroshi flows northeast off the coasts eastern Kyushu, southern Shikok and central Honshu, turning eas ward toward the central Pacific o northeastern Honshu, where meets the cold current, Oyashi flowing down from the north. Th location of this meeting, and co sequently the extent of the war and cold water areas off the Ja anese islands, shifts north an south with the seasons. The su face albacore schools fished by t live-bait fleet, like the skipjack, a associated with the warm curren and their migration through t area of the fishery coincides wi the northward extension of t Kuroshio in spring and summer.

Fleet Bases

Tuna live-bait boats are regi tered (fig. 1) in all prefectures

[4] The traditional boundaries of these fishing grounds are slightly different from those of the statistical areas of the same names, wh were laid out on meridians 10° apart. T "nan" in the names of these areas mea south, and the areas are designated by th locations south of the former provinces Satsuma, Kii, and Izu.

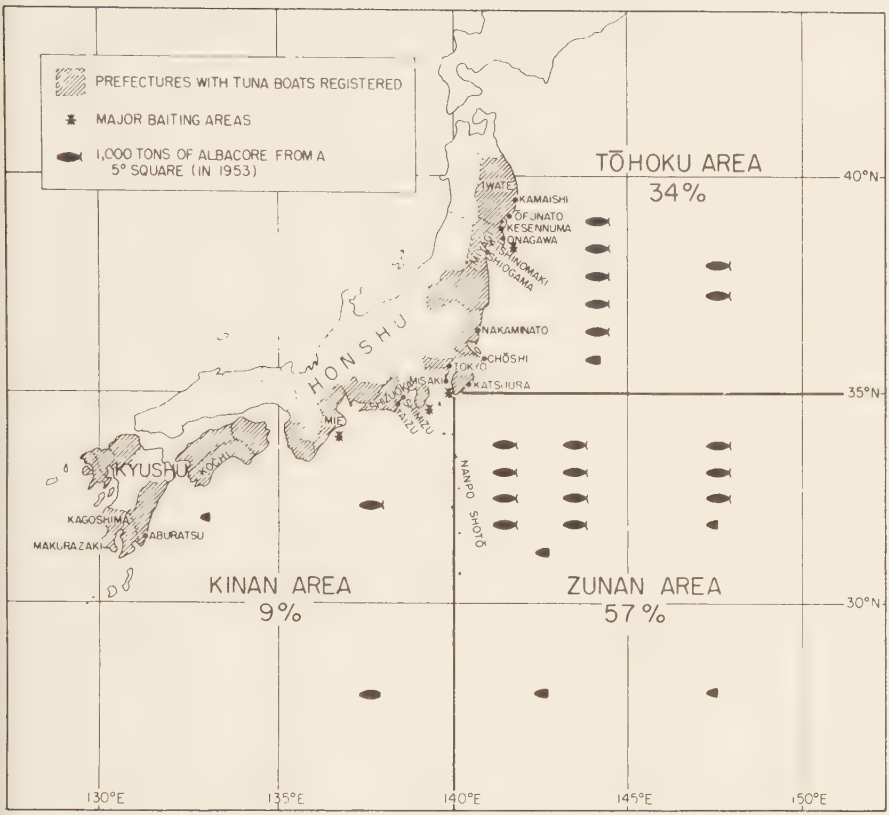

Figure 1.—Location of albacore fishing areas, baiting grounds, and bases. Percentage figures are the portion of the 1953 catch taken in the area. (Based on data prepared by Statistics and Survey Division, Japanese Ministry of Agriculture and Forestry, 1955.)

the Pacific coast of Honshu, except Aomori, the northernmost prefecture, in all four prefectures of Shikoku, and in all but two of the seven prefectures of Kyushu. Table 6 indicates certain peculiarities in the distribution of these boats and their operations. Some prefectures, such as Kochi in Shikoku, have large fleets of small coastal skipjack boats, of less than 20 tons gross, but few of the larger high-seas vessels, which bring in the bulk of the summer albacore catch. Other prefectures, such as Mie, have a considerable number of large boats, which, however, seldom work out of ports in their home prefecture. In 1952, for example, only 5 percent of the catch of the fleet registered in Mie Prefecture was landed in Mie ports. In northern Honshu, Miyagi Prefecture has a sizeable fleet of large boats and important albacore landings, but no small coastal skipjack boats are registered there.

The reasons for these peculiarities of distribution may be found in the historical development and geographical setting of the fishery. Some Japanese authorities

Table 6.—Geographical distribution of registry of tuna live-bait boats and of trips landed, 1953

[By tonnage class of vessel]

Prefecture and port	Number of registered boats weighing—		Number of trips landed by vessels weighing—				
	<20 tons	>20 tons	<20 tons	20–50 tons	50–100 tons	>100 tons	>20 tons
Shizuoka	662	176	16, 260	1, 830	1, 260	870	3, 960
Yaizu				350	920	660	1, 930
Shimizu				20	230	190	440
Numazu				880	90	0	970
Ito				340	0	20	360
Ajiro				190	20	0	210
Shimoda				50	0	0	50
Kagoshima	0	54	140	380	1, 100	160	1, 640
Makurazaki				190	660	120	970
Yamakawa				170	420	30	620
Kagoshima				20	20	10	50
Miyagi	0	75	0	0	530	480	1, 010
Kesennuma				0	90	270	360
Onagawa				0	210	90	300
Ishinomaki				0	140	60	200
Shiogama				0	90	60	150
Mie	1, 124	109	14, 241	170	100	90	360
Nakiri				70	60	40	170
Hikimoto				50	20	0	70
Owashi				40	20	0	60
Hamajima				10	0	10	20
Tasoura				0	0	20	20
Yadoura				0	0	20	20
Kanagawa: Misaki	273	10	5, 480	0	220	110	330
Miyazaki	319	49	5, 520	150	60	0	210
Nango				130	0	0	130
Aburatsu				0	40	0	40
Sotonoura				20	20	0	40
Ibaraki	189	53	1, 888	0	140	0	140
Nakaminato				0	100	0	100
Hiraiso				0	30	0	30
Isozaki				0	10	0	10
Chiba	605	3	15, 451	70	20	0	90
Katsuura				70	0	0	70
Chōshi				0	20	0	20
Iwate: Ōfunato	0	7	0	0	30	40	70
Tokyo: Tsukiji	29	12	301	0	30	30	60
Fukushima	118	18	1, 217	0	40	20	60
Ena				0	40	10	50
Onahama				0	40	10	10
Kochi	968	5	48, 095				0
Nagasaki	249	0	4, 421				0
Ehime	185	0	10, 901				0
Wakayama	141	13	1, 571				73
Fukuoka	28	0	952				0
Tokushima	19	27	391				311
Saga	5	0	35				0
Aichi	0	11	0				2

Sources: Annual Report of Catch Statistics for 1953, and Recent Skipjack and Tuna Fishing as Seen in Catch Statistics, 1955. Although both sources are compilations of the Statistics and Survey Division, Japanese Ministry of Agriculture and Forestry, there are numerous discrepancies between their figures.

(Imamura 1953) hold that the Wakayama-Mie area of south central Honshu (known as Kishu) is the cradle of the skipjack fishery and that the techniques spread both north and south along the Pacific coast from that area. Be that as it may, the early centers of the fishery in the days of sails and oars appear to have been generally on promontories extending out toward the fishing grounds in the Kuroshio. Such areas often had poor internal communications, but as long as the vessels and catches were small the local markets could absorb the production. The invention of katsuobushi, or hard-dried skipjack loins (in the 17th century, according to Yamaguchi 1947), supplied a way in which skipjack could be processed anywhere with very simple equipment into an imperishable product that could be shipped by sea to the major population centers. At this stage the small bases scattered along the coast were adequate for the fishery. Then came the trend to larger, powered vessels that required more capital, better port facilities, and larger bait supplies, and that landed fares which no small local market could absorb. With the growth of great urban centers requiring huge supplies of fresh fish, the operations of the fishery became more and more concentrated in a few ports strategically located with respect to the fishing grounds and railroad lines to the major population centers. Meanwhile many of the old skipjack fishing ports declined in importance (Hara 1954). The traditional skills have survived, however, in Kishu and other old skipjack coasts. Many fishermen from these areas serve on vessels registered in other prefectures, while numerous fine boats working out of the great tuna ports carry inscribed on the stern the name of some small cove to which they may return only two or three times a year.

Mie Prefecture, as previously mentioned, is an interesting example of a prefecture with a strong tradition for tuna fishing and a large fleet but without important operating bases. In 1953, the high-seas (more than 20 tons) live-bait boats registered in this prefecture made a total of 1,420 trips, of which only 18 percent were from bases in the home prefecture. For this reason the seasonal movements of the Mie fleet give a particularly clear picture of the general pattern of movement of the fishery.

In February and March of 1953, activity was at a low ebb and consisted of skipjack fishing along the Ryukyu chain from the bases of Makurazaki and Kagoshima in southern Kyushu. April found most of the boats fishing out of home ports in Mie Prefecture, but some were still working from the south Kyushu bases and several had already moved northeastward up the Honshu coast to Yaizu in Shizuoka Prefecture. In May, activity picked up considerably, and although the number of trips based on Makurazaki increased to 40, the real center of operations of the Mie fleet shifted east from the home prefecture to Yaizu, with 100 trips, while 20 cruises were made out of the Kanagawa Prefecture port of

Misaki, still farther to the northeast. In June, the peak month for pole-and-line albacore fishing, the main base for Mie boats was Misaki, followed by Yaizu, and the southern port of Makurazaki showed almost no activity. July found the Mie fleet at the height of its activity for the year, with 410 trips distributed among bases in three areas.

Vessels fishing off northeastern Honshu made 170 trips, divided fairly evenly among the ports of Ōfunato, Kesennuma, Onagawa, Ishinomaki, Shiogama, and Chōshi. Yaizu was still the leading base with 100 trips, which with 40 others from Shizuoka Prefecture ports indicated that quite a few boats were still working off central Honshu. In addition, there were 100 trips out of Mie Prefecture ports by boats fishing in the Kinan area. The total number of trips fell off to 260 in both August and September, with most of the activity concentrated in northeastern Honshu ports, and by October live-bait fishing by Mie boats was nearly at an end, with only 10 trips, all from Yaizu.

The trend toward concentration of landings in a few ports is especially strong in the case of the albacore fishery. Being primarily an export product, the albacore must be landed where canneries or freezing and cold-storage facilities are available. Albacore landings (tables 7 and 8) and the operations of large live-bait boats (table 6) are strongly concentrated at Yaizu and Shimizu in Shizuoka Prefecture, at Misaki in Kanagawa Prefecture, at Tokyo, and in northern Honshu at Kesennuma and Onagawa in Miyagi Prefecture and Nakaminato in Ibaraki Prefecture (fig. 1). The importance of the Shimizu-Yaizu area is partly due to its having been the first place in Japan where tuna were canned in plants set up to pack mandarin oranges, and it is still alternating this activity with tuna canning. There are said to be about 60 plants in this area that can tuna.

Table 7.—Annual albacore landings, by prefecture, 1952–55

[All fishing methods]

Prefecture	Tons landed in—			
	1952	1953	1954	1955
Shizuoka	34,610	28,959	25,902	22,269
Kanagawa	8,439	10,065	11,666	6,665
Miyagi	8,179	4,675	5,635	3,264
Tokyo	6,574	4,894	7,509	5,345
Ibaraki	2,308	4,688	3,614	4,451
Chiba	1,204	712	314	343
Wakayama	1,154	989	1,295	1,047
Kochi	760	579	116	273
Kagoshima	712	372	149	75
Fukushima	542	393	161	211
Mie	422	116	79	240
Iwate	397	269	145	67
Osaka	228	327	397	261
Ehime	137	211	45	169
Aichi	33	33	0	0
Tokushima	25	21	0	0
Nagasaki	12	0	0	12
Aomori	8	4	4	8
Miyazaki	4	4	0	0

Source: Annual Reports of Catch Statistics, Japanese Ministry of Agriculture and Forestry, for the years concerned.

Fishing Grounds

The grounds of the summer fishery for albacore lie, for the most part, in the three major statistical areas that the Japanese call the Kinan, Zunan, and Tōhoku areas, (fig. 1) approximately between 25° N. and 40° N. latitude, 130° E. to 160° E. longitude. The boundaries of these areas vary slightly in different Japanese publications. Apparently the only published analysis of the distribution of albacore

Table 8.—Monthly albacore landings by prefecture, April–August 1953

[All fishing methods]

Region and prefecture	Tons landed in—				
	April	May	June	July	August
Northern:					
Iwate	0	0	54	109	0
Miyagi	79	99	1,456	761	0
Fukushima	0	67	269	29	0
Ibaraki	455	823	1,220	269	0
Central:					
Chiba	12	124	70	21	0
Tokyo	439	186	1,270	199	12
Kanagawa	261	1,353	6,027	505	124
Shizuoka	1,283	3,144	8,499	2,511	8
Aichi	8	17	0	0	0
Mie	17	59	0	0	0
Southern:					
Wakayama	63	25	4	0	0
Tokushima	0	12	4	0	0
Kochi	0	25	105	319	4
Ehime	0	59	33	116	0

Source: Annual Report of Catch Statistics, Statistics and Survey Division, Japanese Ministry of Agriculture and Forestry (1954).

fishing effort and catch within these broad areas is that contained in Recent Skipjack and Tuna Fishing as Seen in Catch Statistics, compiled by the Statistics and Survey Division, Agriculture and Forestry Economics Bureau, Japanese Ministry of Agriculture and Forestry (1955). The report covers only 1953, a year that seems to have presented no conspicuous anomalies, and the data are broken down into squares of 5° of latitude and longitude or areas approximately 300 miles square. The picture thus presented is not one of fine detail, but since it is the best available, it has been made the basis of the following discussion.

The Zunan sea area—roughly the waters south to southeast of Tokyo Bay, and including the Izu Islands and Nampo Shotō—which is second to the Tōhoku or northeastern area in skipjack landings, produced some 14,417 tons of albacore in 1953, or 57 percent of the pole-and-line albacore catch. Within this area the bulk of the catch came from the 5° square on the east side of the Izu Islands (30°–35° N., 140°–145° E.), with 9,690 tons, and from the next block to the eastward (30°–35° N. 145°–150° E.), with 3,613 tons. Next in importance among the major sea areas was the Tōhoku, with 8,671 tons, or 34 percent of the total. Here the block adjacent to the coast at 35°–40° N. had the highest landings, 5,424 tons, followed by the next block to the east, with 2,137 tons. The Kinan sea area, south of western Honshu and east of Kyushu, which slightly surpassed the Zunan area in skipjack landings, was a poor third in albacore, with only 2,327 tons or 9 percent of the catch, over half of it from the 5° block at 30°–35° N., 135°–140° E., in the northeastern corner of this sea area.

It is interesting to note, as an indication of the degree to which the grounds of the summer albacore and skipjack fisheries overlap, that of the 12 statistical blocks (5° squares) from which pole-and-line albacore catches were reported in 1953, 7 had bigger catches of skipjack than of albacore, and there was no block having a large albacore catch without correspondingly large skipjack landings. The most purely albacore ground was the square at 25°–30° N., 145°–150° E., where 74 percent of the catch was albacore. Next highest was the square at 35°–40° N., 155°–160° E., with 67 percent albacore. Only two other blocks—those at 30°–35° N., 140°–150° E.—had more than half of their live-bait tuna catch in albacore, with 58 percent in each case.

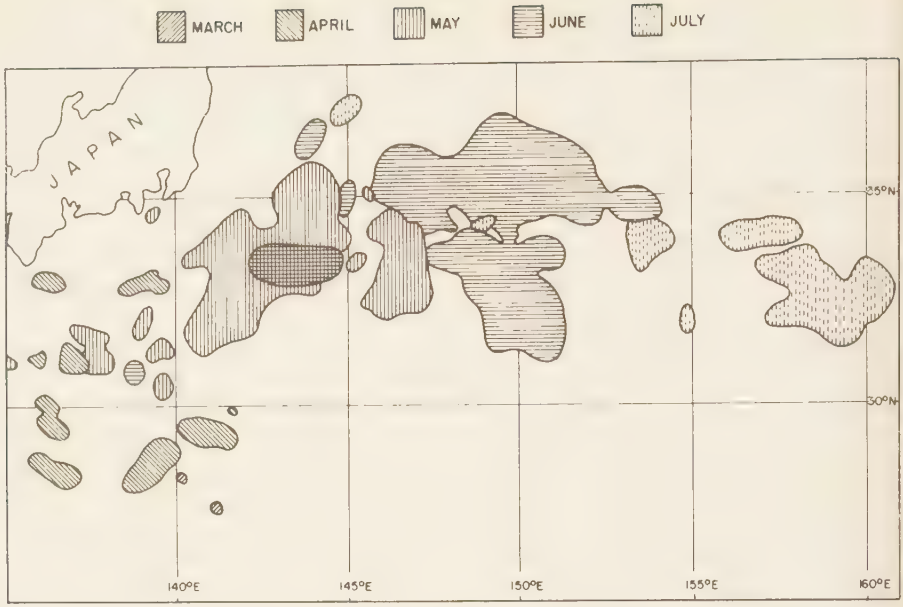

Figure 2.—Simplified composite chart of the distribution of summer albacore fishing grounds in 1953, 1954, and 1956, adapted from Mie Prefecture Fisheries Experiment Station reports for those years. (The north-south extent is exaggerated, particularly at 150° E., since the southernmost grounds appeared only in 1953, when the whole pattern appeared to be pushed to the south.)

The foregoing breakdown in terms of such large areas gives a deceptively diffuse picture of the geography of the albacore grounds. The distribution of the fishing grounds (fig. 2) is focused into a more meaningful, but perhaps oversimplified, outline in charts published in several annual reports of the Mie Prefecture Fisheries Experiment Station (1952, 1955, 1957). For the 3 years 1953, 1954, and 1956 these plots show quite similar distributions of the grounds in the form of a broad arc having its left (western) end anchored in the Kinan sea area near the Nampo Shotō island chain at around 30° N., 140° E., sweeping up northeastward parallel to the south coast of Honshu, and gradually turning to the east along the latitude of Tokyo Bay (about 35° N.). This band of albacore grounds, which appears to average 200 to 300 miles in breadth, reaches farthest north at 36°–37° N. latitude around the longitude of 150° E., and thence drops off to the southeast, ending in the area around 32°–33° N., 160°–165° E. The whole arc is not fished simultaneously, the season beginning in the west and ending in the east. Since the distance of the grounds from port varies from less than 100 miles at the western end to over 1,000 miles at the eastern, there is a progressive withdrawal from the fishery of the smaller boats which return to skipjack fishing as the albacore move offshore.

The three plots on which figure 2 is based also show that during the 6-year period from 1951 to 1956

there was an eastward extension of the albacore grounds from about 155° E. to 165° E. longitude. This undoubtedly reflects the growing proportion of larger vessels in the fleet. Japanese albacore fishermen give as one of their reasons for abandoning the pursuit of the albacore on these easternmost grounds the belief that the schools become more scattered there and harder to find. It may be proving possible to cope with these difficulties more effectively as the number of large boats following the albacore out beyond 1,000 miles increases, for this fleet relies to a high degree on cooperative scouting and radio reporting. Thus the ability of the fleet to keep contact with the schools should be enhanced by the addition of more boats capable of operating on the distant grounds.

Season and Water Temperatures

The normal seasonal pattern of development of the Japanese summer fishery for albacore is for sporadic catches of small numbers of fish to begin in March and continue through much of April along the Izu Islands chain and the Nampo Shotō and in the Kinan area— the albacore being taken at this time by boats operating mainly for skipjack and small bigeye tuna. Sometime between the latter part of April and the end of May the first large catches are made and the fleet begins to concentrate in earnest on albacore fishing. Kimura (1942) recorded the dates on which daily catches of around 1,000 fish per boat began to be made in the period of 1936–39 as ranging from April 18 to May 29, the locations being 120 to 300 miles southeast of Tokyo Bay. Reports for more recent years (Mie Prefecture Fisheries Experiment Station, 1952, 1955, 1957) show a similar early-season development. By the middle of June (rarely in the latter part of May) the landings rise steeply to their peak for the season (table 9 and fig. 3). Simultaneously, skipjack landings drop, indicating a real shift in fishing effort (fig. 4). At this time, fishing is centered well offshore around 150° E. and at its farthest north for the season, extending as far as 37° N. Albacore are still being fished, however, between this ground and the coast, often on two or three distinct grounds at different longitudes. In some years a ground may develop close in to the coast of northeastern Honshu at a slightly higher latitude than that reached by the offshore grounds, and persist into early July. In July the offshore fishing activity shifts east to 160°–165° E. and south to 33°–34° N., the fishing nearer the coast south of 35° N. fades out, landings decline rapidly, and by the end of July the albacore season is virtually over and the fleet has gone back to skipjack fishing. It seems likely that the steepness with which the catch curve rises and declines does not really represent the way in which the albacore become available in the area of the fishery, but reflects the fact that most of the fleet fishes skipjack except during the brief period when albacore are at their highest level of abundance.

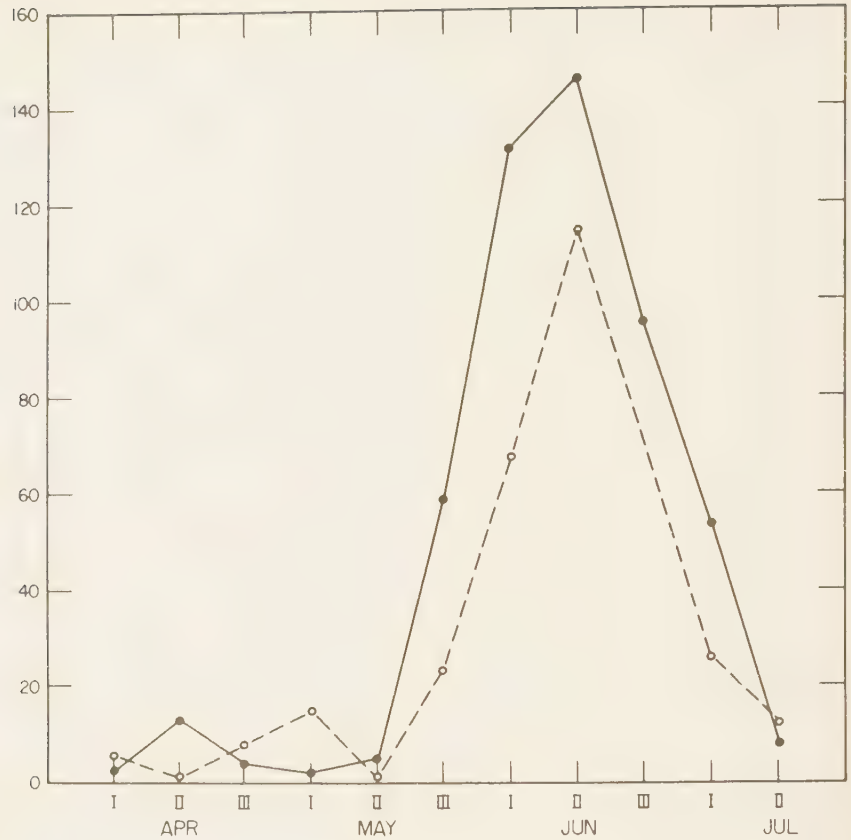

Figure 3.—Trends of albacore landings by 10-day periods (Roman numerals), April to July, 1952 (solid line) and 1953 (broken line), at the ports of Shimizu and Yaizu. Vertical scale is in 10 thousands of kan, equal to slightly more than 41 tons. (From Tokai University, 1954.)

Table 9.—Total Japanese albacore landings, by months, April to August, 1947-55

[All fishing methods]

Month	Tons landed in—					
	1947–50 (average)	1951	1952	1953	1954	1955
April	992	1, 333	2, 871	2, 697	3, 827	4, 700
May	1, 372	3, 735	4, 414	6, 023	3, 661	7, 889
June	4, 885	9, 292	36, 803	24, 098	9, 954	10, 922
July	1, 393	2, 725	6, 565	4, 857	10, 549	2, 441
August	629	64	120	157	1, 804	314

Sources: Figures for 1947 to 1951, from Katsuo to Maguro, Nos. 26 and 28 (Japan Federation of Tuna Fishery Cooperative Associations, 1952); figures for 1952 to 1955, from annual reports of catch statistics, Japanese Ministry of Agriculture and Forestry.

The Japanese believe that the rate at which these developments occur and the details of albacore availability over this expanse of fishing grounds and throughout this season of approximately 3 months are controlled by the way in which the seasonal warming of

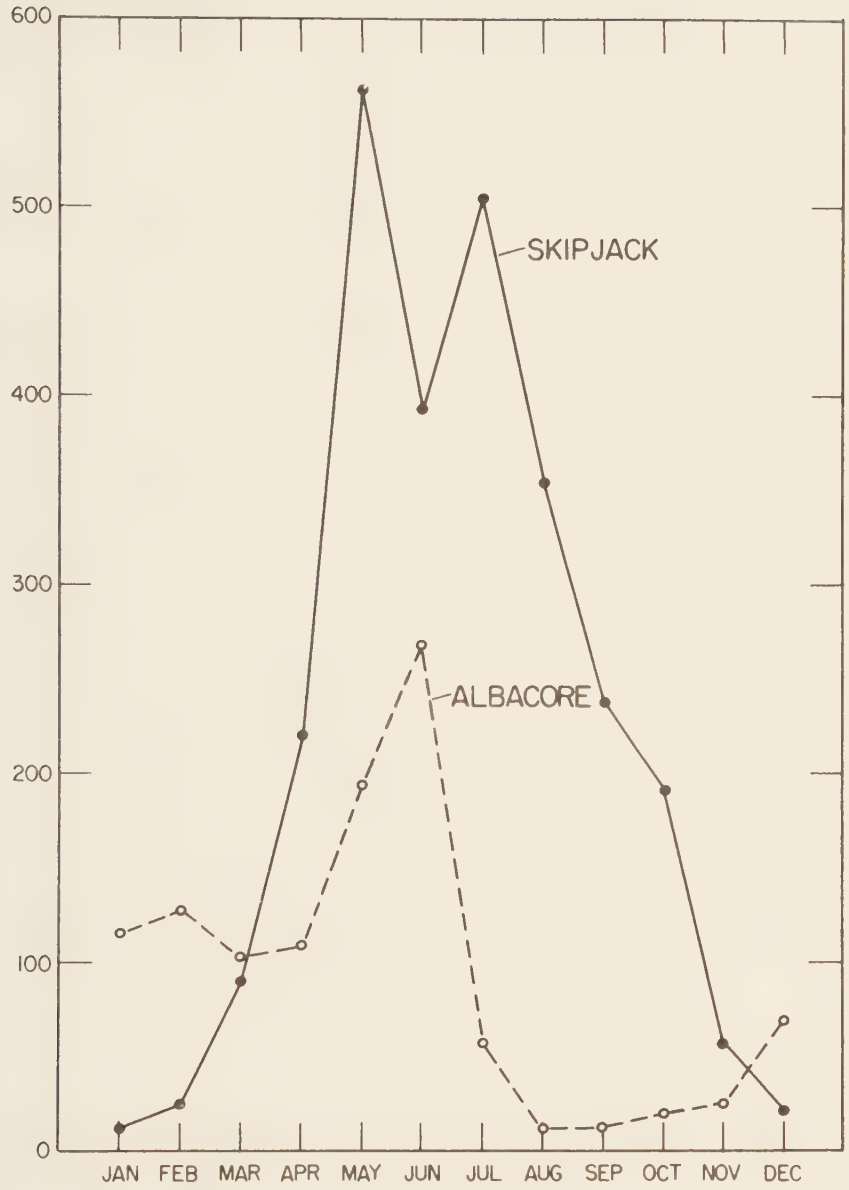

Figure 4.—Trends of monthly landings of skipjack and albacore in 1955. Vertical scale is in 10 thousands of kan, equal to slightly more than 41 tons. Similar drops in skipjack landings appeared in June in 1952, 1953, and 1954. (From annual reports of catch statistics, Japanese Ministry of Agriculture and Forestry.)

the area by the Kuroshio progresses. This belief is based on the assumption that water temperature is the main factor controlling the development of good albacore fishing. The range of optimum water temperature for albacore fishing in May and June (surface-water temperatures at which the largest numbers of albacore were

taken) is given as 64°–70° F., with the catch maximum at about 68° F., by Uda and Tokunaga (1937), while a report of the Miyagi Prefecture Fisheries Experiment Station (Sasaki 1939) states that over a number of years 50 to 80 percent of the summer albacore catch was taken at 68°–70° F., the next most favorable temperatures being 71°–72° F., 66°–67° F., and 73°–74° F., in that order. In Japan, these surface temperatures are given great weight in scouting for albacore and in reporting and forecasting the fishing situation. The way in which the pattern of surface temperature distribution develops is thought to affect the success of a summer albacore season mainly through its effect on the early part of the season in the western grounds. In some years the strength of the warm Kuroshio pushes northward in such a way that isolated masses of water of suitable temperature lie close in to the southeast coast of Honshu until the end of May or even later. Not only is this condition thought to favor successful fishing by concentrating the schools of albacore, it also prolongs the period during which the smaller, short-range skipjack boats can effectively fish albacore (Inoue 1955). In years when the Kuroshio comes to full strength unusually early, as in 1954 (Tokai University, 1954), these isolated cool-water areas either do not develop or are shortlived, the schools move offshore to the northeastward more rapidly, and fishing is poor for the coastal fleet. The effect of such fluctuations in hydrographic conditions on the overall success of the season is probably decreasing as the role of the larger boats operating on the more distant grounds becomes more important.

FLEET AND OPERATING REGIME

Japanese live-bait tuna boats and their fishing gear have been described and figured by several authors in recent years (Cleaver and Shimada, 1950; Shapiro 1948; Japanese Fisheries Agency, 1955) and so will be treated only briefly here. The most conspicuous characteristics of these craft are the long, high bowsprit bearing prolongations of the fishing racks, the racks extending along one or both sides of the vessel and around the stern, only about 1 foot below the high gunwale, and the spray-system pipes, with closely spaced nozzles, paralleling the racks. The superstructure is all abaft the beam, and the long open welldeck has 9 or 12 hatches. Those hatches along the sides lead to the iced fish holds and those along the midline open into the live wells. Pump circulation for bait wells has not yet caught on in Japan, and the practice of circulating the water through simple openings in the vessel's bottom is almost universal in Japanese bait boats. Most of the boats of less than 130 tons gross are of wooden construction; all of the larger ships are steel.

The strength of the fleet engaged in the summer fishery for albacore is not exactly determinable

from published statistics, which present ill-defined and irreconcilable figures (tables 5 and 10). Figures similar to those in table 5 are presented in Japanese Fisheries (Japanese Fisheries Agency, 1955), where they are identified as "licensed skipjack and tuna [i.e., live-bait and longline] fishing boats." Probably they include only the larger boats and perhaps only those whose owners belong to the Japanese Federation of Tuna Fishing Cooperative Associations. The figures on live-bait boat strength for 1953, as given in table 10, are confirmed in the publication, Recent Skipjack and Tuna Fishing as Seen in Catch Statistics (Japanese Ministry of Agriculture and Forestry, 1955). Since this table has been compiled from the Japanese Government's official annual fisheries statistics report, it should perhaps be accepted as the best information available.

Table 10.—Number of powered skipjack pole-and-line vessels, by gross tonnage classes, 1953–55

Year	Number weighing—				
	<20 T.	20–50 T.	50–100 T.	100–200 T.	>200 T.
1953	4,101	148	296	178	0
1954	4,804	180	303	227	4
1955	4,646	162	260	279	14

NOTE.—As late as 1955 the annual statistical report showed 508 nonpowered vessels engaged in tuna pole-and-line fishing.
Source: Annual reports of catch statistics, Japanese Ministry of Agriculture and Forestry.

It appears from tables 5 and 10 that by 1948 the Japanese tuna fleet had already surpassed its prewar strength and that since that time the fleet has continued to expand, at least to 1954. It is also clear that the postwar years have seen a steady increase in the average size of Japanese tuna boats. There is a hint of a turning point in 1954, with the number of boats in the smaller size classes showing a decline in 1955, while the number in the larger tonnage classes continued to grow (table 10). It may be noted in passing that the increase in size of live-bait boats has not been as striking as in that of tuna longline boats, which are commonly being built over 500 tons and, exceptionally, to 1,000 tons gross. For live-bait boats, under present operating and marketing conditions, the practical limit seems to be somewhere in the vicinity of 300 to 320 tons. This is because the Japanese live-bait tuna fishery is primarily a skipjack fishery. The skipjack grounds are largely within the range of the smaller vessels, the market demands iced rather than frozen skipjack, and iced skipjack cannot be landed in good condition from cruises of the length necessary to load up a larger boat. Boats in the 300-ton class have an advantage when it comes to pursuing the albacore schools east to 165° E., but they are probably not economical for skipjack fishing. In fact, many of the boats over 150 tons now turn to South Seas longlining rather than to skipjack fishing after the albacore season ends.

The thousands of coastal (i.e., less than 20 tons gross) live-bait boats that swarm around the Japanese coasts make a surprisingly small contribution to the albacore catch, or for that matter, to the skipjack landings. The only

species in which they lead is frigate mackerel. In 1953, for example, when 4,917 of these small vessels were operating as compared with 622 boats of more than 20 tons, they landed only 736 tons of albacore, or about 2 percent of the total pole-and-line catch of this species. As noted earlier (p. 3), albacore made up only about 4 percent of the catch of the coastal boats in 1953 as compared with 33 percent of that of the larger boats. Albacore occupied an even bigger share, 36 percent, of the high-seas catch in 1952, but earlier, in the period of 1947–49, the average was only 8 percent, perhaps in part because of the smaller number of big boats fishing then.

A live-bait boat of around 200 tons gross, the class which appears to be the backbone of the albacore summer fishery, will make from 3 to 5 trips in a season primarily to fish for albacore. On nearly all of these cruises some skipjack are taken, and small amounts of albacore may also be caught on earlier or later trips that have skipjack as their primary object. Length of trips averages about 5 days for 20- to 50-ton, 10 days for 50- to 100-ton, and 12 days for 100- to 200-ton boats, of which 2, 4, and 5 days, respectively, are spent in actual fishing (Japanese Ministry of Agriculture and Forestry, 1955).

More detailed information is available concerning operations in several recent years from the 196-ton *Jini Maru*, which, although it was the fisheries guidance vessel of Mie Prefecture, worked very much like an ordinary commercial craft (Mie Prefecture Fisheries Experiment Station, 1952, 1953, 1955, and 1957). In the 4 years 1951, 1952, 1954, and 1955, this ship made from 7 to 14 live-bait fishing cruises per season, the earliest cruise beginning April 11 and the latest ending October 5. Cruises were from 6 to 17 days in duration, averaging about 12 days. In 1951, albacore were taken on the first three trips (May 22–July 2) but formed the greater part of the catch only on the second cruise (June 8–19). In 1952, substantial quantities of albacore were taken on all trips from the second to the fifth (May 21–July 12). In 1954, some albacore were caught on the first and second cruises and on the fifth through the seventh cruises of the 11 cruises made that season, but they did not form the major part of the catch on any trip. In 1955, when 14 trips were made, albacore figured in the catch on the third through the sixth cruises (May 11–July 6), predominating on the fourth and fifth (May 28–June 23). The *Jini Maru*'s records also show small numbers of bigeye tuna taken, usually in association with skipjack, on quite a few of her cruises.

Few data have been found on the average size of the fares brought in from albacore cruises. The analysis of the 1953 figures by the Statistics and Survey Division, Japanese Ministry of Agriculture and Forestry (1955), gives a figure of only 642 pounds as the average albacore landings per trip for the high-seas fleet, but since this is apparently averaged out over the whole skipjack season, it is not a very meaningful statistic. Perhaps more rel-

evant is the figure given in the same source for the average albacore catch per trip in the 5° block at 30°–35° N., 140°–145° E., the statistical area having the highest total albacore catch in 1953 and in which albacore made up 58 percent of the pole-and-line catch. Here the average was 17,350 pounds per trip. For the *Jini Maru*, in 1951 albacore catches ranged from 710 to 91,019 pounds, averaging 38,843 pounds, and in 1952, the range was 57,000 to 112,644 pounds, with an average of 89,949 pounds (Mie Prefecture Fisheries Experiment Station, 1952, 1953).

Japanese live-bait boats are usually unloaded, fueled, iced, and ready for sea within 24, or at most 48, hours after returning to port. The usual practice is to sail at an hour that will bring the boat to the baiting station early in the morning. Since bait is purchased out of holding nets, baiting generally takes only an hour or two, however, it is quite commonly necessary to visit two or more stations in order to get enough bait for a trip. The duration of cruises seems to be determined in most cases by the length of time the bait supply lasts.

Fishing Method

Scouting for albacore off Japan in summer is carried on by radio intelligence, visual observation, and trolling, in that order of descending importance. Each ship carries a professional radioman whose principal duty is to pick up and relay radio reports on the fishing situation. The intensity of this exchange of information results in a high degree of concentration of vessels on the grounds, it being not unusual to have 25 or 30 boats in sight at one time. Large numbers of lookouts keep watch from dawn to dusk, looking for bird flocks and floating timbers, and also keeping a sharp eye on the activity of other boats in the vicinity. Trolling lines, usually two, are dragged at all times, but are relied on principally for a final evaluation of other signs of fish. Competition among vessels appears to be unfettered by any notions of courtesy or even of caution, and when a boat is on fish, others in the vicinity will often maneuver recklessly close and attempt to steal the school.

Albacore fishing is done with two-pole rigs, thus cutting down the number of hooks to half that used when working on skipjack. Since the average numbers of fishermen are 29 on 20- to 50-ton boats, 45 on 50- to 100-ton boats, and 54 in the 100- to 200-ton class, this still leaves fishing power at a rather high level. The use of two-pole gear for fish that usually do not go much over 25 pounds is necessitated by the height of the racks off the water. The fishermen are customarily disposed along the port side and around the bow and stern, with the best fishermen on the bowsprit where the lift is highest, the old-timers at the stern where it is lowest, and the green hands amidships where the fish bite slowest. The favored lure for albacore is a squid with a lead head, polished cowhorn body, and a chicken-feather tail sheathed in cat skin. Bait is chummed at the stern, amid-

ships, and forward from small tanks which are kept supplied by boys carrying buckets of bait from the main baitwells. The spray system is turned on as soon as fish appear close to the ship and continues to play as long as fishing continues. The jets of water ruffle the surface of the sea and perhaps excite the tuna, and also carry the fishermen's lines away from the side.

The schools of albacore encountered off Japan appear to be generally small, perhaps partly because of the intensity with which they are harried and broken up by concentrated fleet action. The usual pattern of fishing is therefore one of taking a few fish from each of a large number of schools. For example, on two cruises of the *Jini Maru* in June 1956 the number of albacore schools fished per day ranged up to 10 and averaged 3 to 3½. The number of albacore taken from a school varied from 4 to 647, averaging 184 on one trip and 156 on the other. An excerpt from this vessel's fishing log for May 31, 1952, will give some idea of what this fishing is like (and also shows the emphasis given to water-temperature measurement):

Began searching at 0425, heading east. Albacore school at 0623, took 200 fish. Water temperature 70.3° F. At 0740, at 35°32′ N., 164°48′ E., water temperature 67.6° F., small school of albacore, took 49. At 0920, same, took 59, water temperature 68.1° F. At 1050, same, took 140 fish, water temperature 68.1° F. At 1115 a large school of albacore, bit well, took 830, water temperature 68.1° F. At 1310 a small school, took 15 fish, water temperature 68.5° F. At 1335, same, took 173 fish, water temperature 68.4° F. At 1413, same, took 33 fish, water temperature 70.7° F. Between 1500 and 1600 fished albacore 3 times, took 540, water temperature 68.3° F. Fished small schools of albacore twice between then and 1700, took 70, water temperature 68.4° F. Ran out of bait at 1740 and headed for port.

Bait

As noted in earlier remarks on the short turn-around time of Japanese live-bait boats, the bait used in the albacore summer fishery is not caught by the tuna fishermen, but is purchased from bait dealers. This system has the obvious advantage of saving fishing time, and also, a point that the Japanese tuna fishermen consider important, the tuna boats are usually supplied with "tame" bait which has been held for some time and thus avoid the heavy initial mortality often experienced with freshly caught bait. The baitfish are sardine and anchovy taken by various methods. In the only two examples for which published information has been found (Mie Prefecture Fisheries Experiment Station, 1952) the nearly 50,000 buckets of bait sold at the Kamogawa baiting ground in Chiba Prefecture in 1951, and the nearly 20,000 buckets delivered to tuna boats at Kaigata in Kagoshima Prefecture in the same year were almost all anchovy. At the former place the bait was taken in the daytime with seines, while at the latter it was attracted to a light and captured by lift net at night.

Bait is held on the baiting grounds in koari, bag-shaped nets held afloat on octagonal wooden frames and anchored in water deep

enough that the tuna boats can come alongside them. A similar net and demounted frame is carried aboard the tuna boat for the holding of any bait that is left over when the vessel comes into port, as the primitive circulation system will not keep bait alive in the wells of a moored boat. The bait is passed carefully and rapidly from the koari to the bait wells of the fishing boat in buckets, and since the bucket is the unit by which the bait is sold, a careful tally is kept by representatives of both buyer and seller.

The cost of bait is said to account for about 30 percent of the trip expenses of a tuna boat (Mie Prefecture Fisheries Experiment Station, 1952). A bucket (3.2 gallons) of bait, estimated to contain 15 to 16 pounds of fish, has sold in recent years for 1,000 to 2,000 yen, about $2.50 to $5.50,[5] and a boat of around 200 tons gross will use on the average about 250 buckets each trip. An additional expense in connection with bait is the necessity of employing one or two bait buyers, who travel up and down the coast making arrangements to ensure that supplies of suitable baitfish will be reserved for the boat when and where needed.

Major baiting areas are in Kagoshima Bay in southern Kyushu, around the Izu Peninsula in Shizuoka Prefecture, along the Miura Peninsula near the port of Misaki, on both the Tokyo Bay and Pacific coasts of Chiba Prefecture, and in Miyagi Prefecture in the northeast. Ideally, the baiting ground is a sheltered bay or cove where the koari can be safely anchored, close to a good fishing ground for anchovy and sardine, and not too far from a major tuna landing port. In actuality, it is often necessary for a vessel landing its catch at Shimizu, for example, to run all the way up to the Tokyo Bay area to take on its bait for the next trip, and at the peak of the season, when there is strong competition for the available bait, a tuna boat often has to visit several baiting grounds to get together enough bait for a trip. There is some evidence of a tendency for the price of bait to be higher at the northeastern baiting grounds than in central and southwestern Japan.

The tuna-bait fishery, although not well documented, is evidently an important business. Trade papers (Nippon Suisan Shimbun, July 26 and August 16, 1957) have reported estimates that about 1,900 vessels are served by members of the commercial bait dealers association and that the annual value of this business is over $4,000,000. One major baiting ground alone, that of Tateyama on the Chiba Prefecture shore of Tokyo Bay, is reported to gross more than $800,000 annually.

Ice

As the fleet is primarily engaged in fishing skipjack for a domestic market that, by and large, will not accept frozen fish, the boats are equipped to preserve their catch in

[5] According to a newspaper report (Nippon Suisan Shimbun, January 31, 1958), bait dealers and boat owners provisionally agreed on a price of 700 yen per bucket for bait in the 1958 season.

ice or, more exactly, in ice water. Such mechanical refrigeration equipment as is found on bait boats is intended only to cut down ice loss when the vessels engage in longlining during the off season and, therefore, is of small capacity. Block ice is loaded, an average of around 40 tons per cruise for a 200-ton boat, at $5 to $6 a ton, and is broken up with hand tools as needed for cooling the water in the fish holds.

SIZE OF FISH

A number of reports have been published which deal with the size composition of the pole-and-line albacore catch of the summer season. Among these are the reports of Uno (1936a, 1936b) and Uda and Tokunaga (1937), based on samples from the 1935 and 1936 seasons; Aikawa and Kato (1938) and Tauchi (1940), who present data for 1936 and 1937; and Suda (1955, 1956), who covers data for the period 1948–54. The Nankai Regional Fisheries Research Laboratory (1951) has published length frequencies of large samples from 4 catches landed in 1950 and 53 catches landed in 1951. Two annual reports of the Mie Prefecture Fisheries Experiment Station give, in one case (1953), raw length and weight data for small samples (5 to 20 fish) from about 50 individual schools, and in the other (1957), the length-frequency distributions for similar samples. The earlier of these two reports also presents a brief discussion of the geographical distribution of schools of albacore of different sizes and a rough length-weight curve. The earlier workers cited here were more concerned with the age composition of the catch (basing their estimates on Aikawa's readings of vertebral annuli) than with the size composition as such, but Suda attempted to identify length modes in successive years and to trace the fluctuations in abundance of the various size groups in the catch from year to year.

The facts presented in these reports can be practically summarized as follows. The albacore taken on pole-and-line are comprised within a range of 50 to 100 cm. (about 6½ to 47 pounds) with rare exceptions; Suda (1955) sampled one catch of 30- to 37-cm. fish in 1951. This size range is more limited on both ends than is that of the winter longline catch in the same region and, in fact, the bulk of the summer catch lies in most years between 60 and 90 cm. (about 11 to 35 pounds), usually with a strong mode in the vicinity of 80 cm. (25 pounds). In 1935, according to Uno (1936a), more than 90 percent of the fish were between 19 and 31 pounds, with the mean for this group at 22 pounds. In 1936, according to Tauchi (1940), about 46 percent of the catch was between 20 and 29 pounds in weight, and in 1937 about 30 percent fell between 19 and 27 pounds. In a more recent example, the data from the 1956 operations of the Mie Prefecture fishery guidance vessel *Jini Maru*, the range of average weight in 51 schools sampled was from 14½ to 31 pounds, with the averages for 34 of the schools falling between 20 and 23 pounds.

Suda (1955), studying data for 1951 to 1954, claimed to find from three to five size groups in each year's catch and concluded that the groups above 70 cm. (about 17 pounds) appear consistently from year to year, whereas there is more variation in the availability of the groups of smaller fish.

In the Japanese trade the size of fish is discussed in terms of "kan," a unit of slightly more than 8 pounds. Albacore under 3 kan (about 25 pounds) are called small and those over that weight, large. Published information does not give any clear picture of geographical or seasonal differences in the distribution of fish of different sizes, although it is commonly said that more small fish are taken on the grounds closer to the coast. Mie Prefecture data for the 1952 season show that 97.6 percent of the albacore from the Kinan area and the west side of the Izu chain (west of 140° E.) were large, while of the fish taken east of 140° E., 69.4 percent were small; however, the fact that the main mode in the overall size composition shifts around the 3-kan dividing line can make the proportions of large and small fish differ sharply from area to area and year to year. Thus in 1951, 67.7 percent of the schools were large fish, but in 1952, 78.0 percent were small (Mie Prefecture Fisheries Experiment Station, 1952, 1953).

Practically, the size characteristics of the albacore taken in the Japanese summer fishery can be summarized as quite uniform, large enough to give good recovery in processing, but not so large as to have much "green" or offcolor flesh—all in all, a highly desirable raw material for white-meat tuna packers.

MARKETING AND UTILIZATION

It is inappropriate in a paper that purports only to describe one segment of the Japanese albacore fisheries, which in turn are only one part of the Japanese tuna-fishing industry, to attempt a complete account of the domestic and foreign utilization of Japan's tuna production. Unfortunately, the data necessary to separate the trade in summer-caught albacore from that in winter- and mothership longline-caught albacore are not available. The following paragraphs, therefore, aim only to give a general idea of what happens to the summer albacore catch and of its commercial significance.

When the albacore are landed, they are immediately laid out on the floors of auction sheds on the quay in lots according to size and condition and are bid in by representatives of freezers, canners, and fresh-fish dealers. Prices vary widely, depending on the suitability of the fish for export or other uses, and fluctuate from day to day according to supply and demand, the latter reflecting in a large degree the exporters' assessment of the United States market. The spread between the high and the low offers at a single port in any week is often as much as $100 per ton, and the variation of weekly average prices within a season may be of the same order. In the early part of the

1956 season, for example, the ex-vessel price averaged around $300, but much of the fish bought at this high price level apparently had to be sold at a loss, and the next year the chastened buyers started out offering only $150–$200 a ton. These sharp ups-and-downs are distressing to the Japanese fishermen, particularly as the natural pattern is for the price to be high when they are not catching much fish and for it to fall about the time they come into port with a full load. The concentration of the fleet on the fishing grounds described earlier often means that when one boat loads up, all load up, and then something like a race for the market often develops.

It is interesting to note that in recent years there have been increasing demands for stabilization of albacore prices by season contracts between boat operators and buyers at the same time that some elements of the United States tuna fleet have been moving toward abandonment of the contract system in favor of auctioning their fish. A basic difficulty of the Japanese albacore trade is that although the demand for the product is greatly affected by the success of the United States fishery in the same year, the season in Japan is nearly over by the time the American season gets into full swing. The result is that the Japanese processors must buy their stock before they are in a good position to estimate what the demand for it may be. It has been suggested that if a method could be devised to forecast during the spring the success of the American albacore fishery, it would be of invaluable help to Japanese fishermen and traders in planning their operations (Inoue 1957).

Assuming that skipjack continue to be fully available to the fleet during the summer albacore season, it would seem that a price differential in favor of albacore would be the most obvious reason for any diversion of fishing effort from skipjack to albacore. Of course, other factors suggest themselves, such as differences in the distance to the grounds where each species is most abundant, the possibility of making a load faster with albacore, which weigh three to four times as much as skipjack, and so forth. In general there does seem to be a clear-cut price advantage to albacore, although the great variability of the ex-vessel prices of both species appears often to obscure or even reverse this relation. For example, the *Jini Maru* in 1951 on cruises from which both species were landed received on the average $38 more per ton for albacore than for skipjack, but similar data for that vessel's 1952 operations show a $13 a ton advantage to skipjack. Market reports published in the Japanese trade press showed in 1956 high albacore prices running generally about $100 more per ton than the high skipjack price on any given day at any particular port, but in the 1957 season this differential was generally much less and was often reversed. Of course, the high skipjack price at any day's auction may represent only a few choice fish bid in for the fresh-fish trade, and it is noted that the low

bid for skipjack is almost always far below the lowest price offered for albacore.

The albacore is so associated with the export trade in the minds of the Japanese that when asked what use is made of this fish in Japan, they will often state that it is all exported. It is obvious that not all of the albacore landed in Japan can meet the quality standards for export, nor can the world's markets absorb all of the albacore that the Japanese catch in a good year. The figures in table 11, which are drawn from a variety of sources, not all of a high reliability, indicate that in some recent years albacore exports have amounted to little more than two-thirds of the catch. In 1955, on the other hand, apparently more albacore was exported than was landed. These difficulties of comparison arise from the fact that export statistics are often not presented on a calendar-year basis and also because frozen and canned albacore may be produced in one year and exported in the next. It appears, however, that over the whole period of 1950–56 a considerable part of Japan's albacore catch, perhaps as much as one-sixth, was consumed domestically. This consumption was in the form of fresh or smoked fish, canned tuna flakes flavored to the Japanese taste, or as one of the ingredients in the increasingly popular fish sausage. Production of canned and frozen fish for export remains, however, the basic objective of the Japanese albacore fishery, and the fact that a certain percentage of the catch is consumed in Japan is largely accidental.

Table 11.—Japanese albacore production and exports, with comparative data on other tuna exports, 1950–56

Year	Catch (tons)	Exports				
		Frozen		Canned		Raw material equivalent of canned albacore (tons)
		Albacore (tons)	Other tuna (tons)	Albacore (cases)	Other tuna (cases)	
1950	32,628	7,329	2,946	665,319	862,057	13,306
1951	32,999	15,999	2,500	403,730	315,390	8,075
1952	65,788	21,628	3,890	849,991	234,089	17,000
1953	56,985	32,783	13,091	900,000	395,004	18,000
1954	57,145	30,543	33,102	792,000	957,374	15,840
1955	44,724	33,118	31,821	1,062,597	955,915	21,452
1956	64,675	22,012	33,393	1,233,383	1,480,681	24,667

NOTE.—The export figures were adapted from a number of sources: Anderson et al., 1953, Survey of the Domestic Tuna Industry, Special Scientific Report: Fisheries No. 104; Japanese Federation of Tuna Fishery Cooperative Associations, Katsuo to Maguro, February 1956; Fishing Industry Weekly No. 171; and weekly newsletters of the Tuna Research Foundation Division, California Fish Canners Association. The accuracy of the figures is thought to be of a low order.

Some figures from a Japanese fisheries yearbook (Suisan Nenkan, 1954 ed.), together with tables 4 and 11, give a general idea of the importance of albacore in Japan's export trade. Before the war (1933–35) fishery products made up about 3 percent of the value of Japan's exports, but this figure rose to 4.5 percent in the postwar years of 1950–52. In the period of 1933–35, tuna products made up

only about 11 percent of Japan's fishery exports, as compared with nearly 33 percent in 1950–52. For the prewar period, 64 percent of the tuna exports, which were mostly canned fish, went to the United States, a figure which increased to 80 percent or better after the war. The proportion of frozen fish in Japan's tuna export to this country—only about 25 percent in 1937—grew to about half of the total exports in 1952, and the bulk of this was albacore. Before the war exports were almost entirely albacore, but in the postwar period yellowfin and skipjack light-meat tuna products have gradually come to make up a larger share of the total (table 11). The concentrated reliance of Japan's tuna export business on the United States market since the war has been a source of worry to Japanese tuna producers, for it lays them open to disastrous consequences if production and price trends, or increased tariffs, should hinder their access to the American market. In recent years they have tried to develop export markets elsewhere with some success, and one recent estimate is that more than 20 percent of Japan's canned tuna exports, most of it albacore, now goes to countries other than the United States (American Tunaboat Association, in correspondence).

The export of canned and frozen albacore from Japan, like that of other species of tuna, is subject to rather strict control through a system of quotas, floor prices, and joint sales arrangements set by industry associations acting under the aegis of the Japanese Government. This system has undergone numerous adaptations in recent years and appears to be developing in the direction of a more concentrated channeling of exports and stricter regulation extending further down toward the primary producer. The basic policy behind the system seems to be to assure Japan of the biggest share possible of the world tuna market while at the same time preventing cutthroat competition among the elements of the Japanese industry, with attendant price cutting that might lead to accusations of dumping and stimulate the raising of tariff barriers abroad against Japanese tuna.

SUMMARY

The world's greatest single fishery for albacore, traditionally the choicest and highest-priced tuna for canning, is carried on by the Japanese during the spring and early summer in the northwestern Pacific. The fishery exploits schools of 15- to 25-pound fish, which migrate rapidly northeastward parallel to the coasts of southern Japan and then turn to the eastward along the latitude of central Honshu. The season is short, from May to July, with a peak in June. The fish are taken on pole-and-line, using live-bait chum, and the techniques and equipment are essentially those that are used for fishing skipjack. Several thousand wooden and steel vessels, ranging in gross tonnage from less than 20 tons to more than

300, contribute to the landing, but the bulk of the catch is made by a few hundred of the larger boats, mainly because the principal albacore grounds lie more than 100 miles off the Japanese coast. Although boats from all areas of the Japanese Pacific coast participate in the fishery, landings are highly concentrated in a few ports of central Honshu, especially in Shizuoka Prefecture.

The fishery has grown up within the past 35 years in response to the demand of the American market for white-meat tuna, and it is essentially aimed at production for export, either as canned or as fresh frozen albacore, to American canneries. From the Japanese point of view this spring albacore fishery is ancillary to the ancient and much larger skipjack fishery, out of which it developed and with which it is still inseparably involved. No part of the fleet engaged in the fishery, nor any of the facilities such as baiting grounds and landing places which serve the fleet, is dependent wholly on the albacore fishery or would cease operation if the albacore export trade were cut off. On the other hand, the prosperity and the rapid growth of the Japanese live-bait tuna fleet in recent years have been due in large part to the good market for albacore, and the export of albacore products has contributed more dollars to Japan's economy than any other fishery product. Fishing activity and landings have been maintained at unprecedentedly high levels during the past half decade, and barring a decline in the availability of albacore in the waters off Japan, it seems likely that this fishery will continue to thrive as long as foreign markets continue to take its products.

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